Population Response Modeling

Goal **Project the relative differences in estimated NSO population performance among the various habitat reserve design scenarios given various assumptions about future habitat changes and barred owl impacts**

Objectives **To use a spatially-explicit population model to evaluate estimated spotted owl population responses to different reserve designs, habitat changes, and barred owl impacts**

What is HexSim?

- **It is a computer simulation model.**
- **It is useful for evaluating wildlife population responses to human activities.**
- **It is modern and sophisticated, but flexible and easy to use.**
- **It can be used with a large range of places, problems, and questions.**

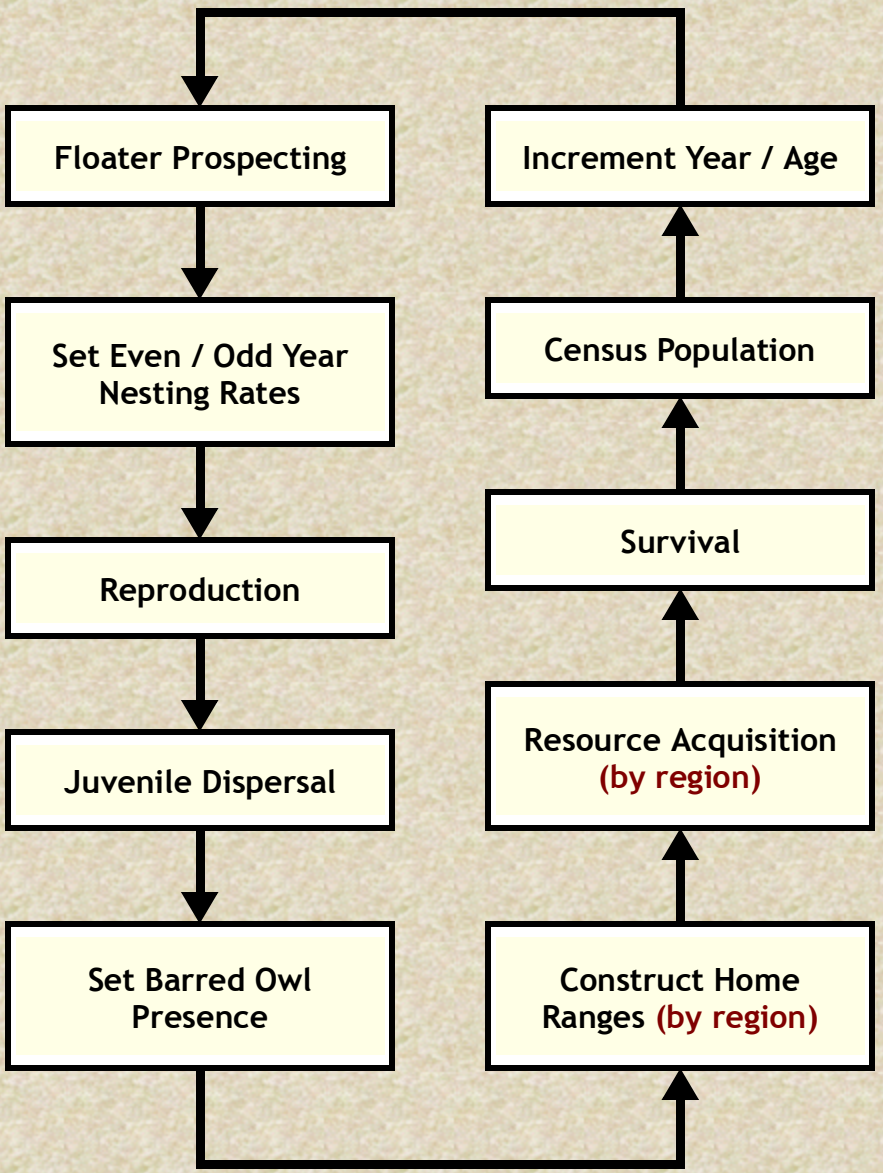
HexSim Inputs

- **Spatial Data.** Can be real or fabricated, one or multiple layers, static or time series...
- **Life History Data.** Can be real or fabricated or a hybrid. Data limits model complexity...
- **Disturbance Regimes.** Spatial, temporal, simple, complex, local, regional, etc...
- **Stochasticity.** Demographic, environmental, life stage-specific, spatially-distributed, etc...

HexSim Outputs

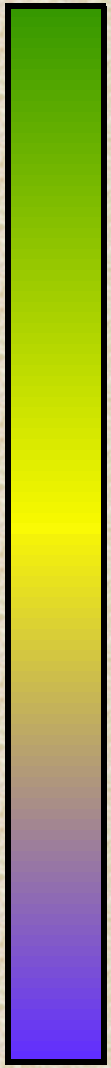
- **Census Data.** Chronological records of user-defined population metrics.
- **Tabular Reports.** CSV files detailing observed vital rates, movements, interactions, etc.
- **Map-Based Reports.** Map files illustrating population performance and interactions.
- **Videos.** Movies showing movement, resource acquisition, occupancy by trait class, etc.

HexSim Spotted Owl Life Cycle

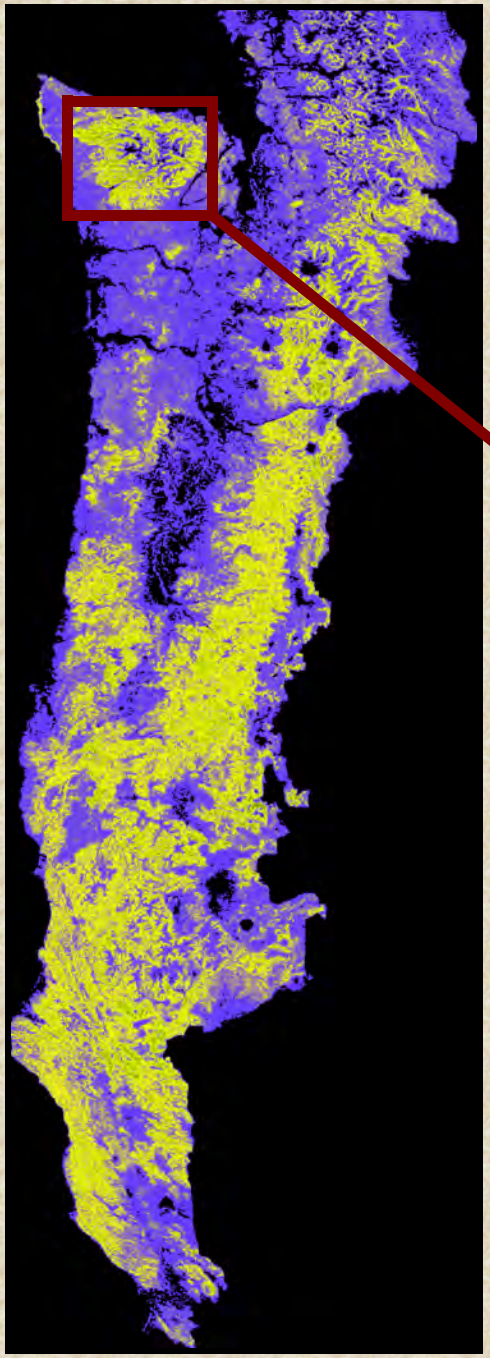


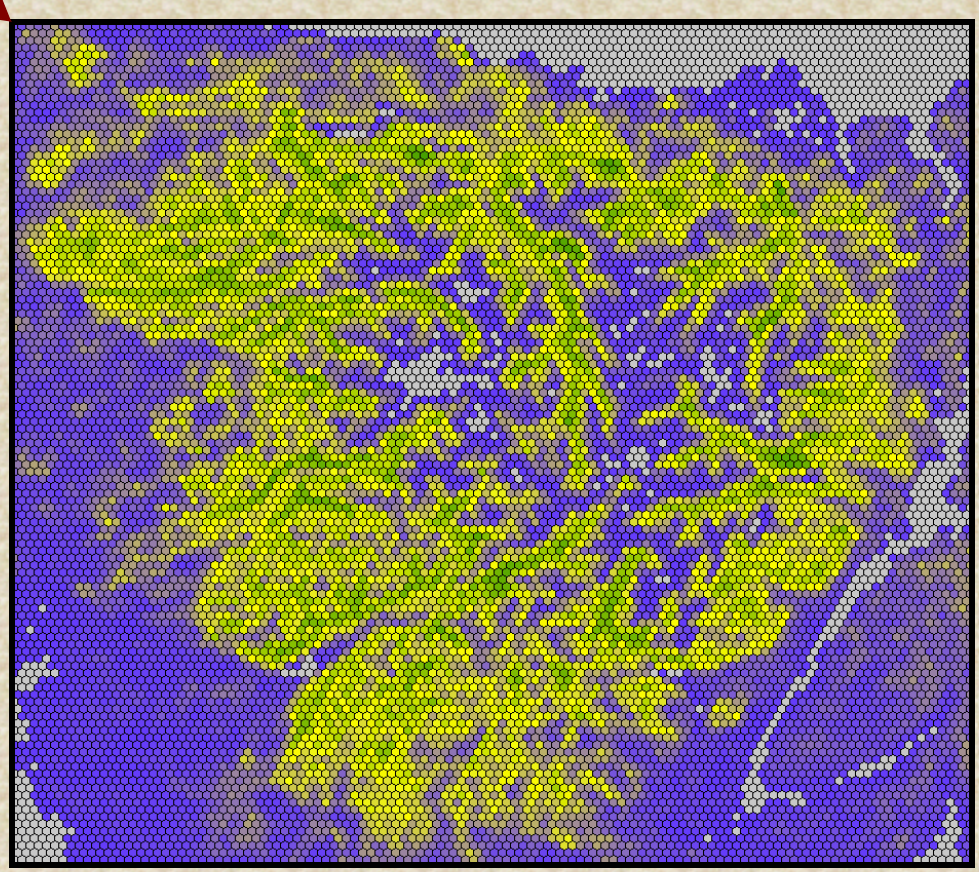
MaxEnt Current Conditions Resource Map

Highest Quality

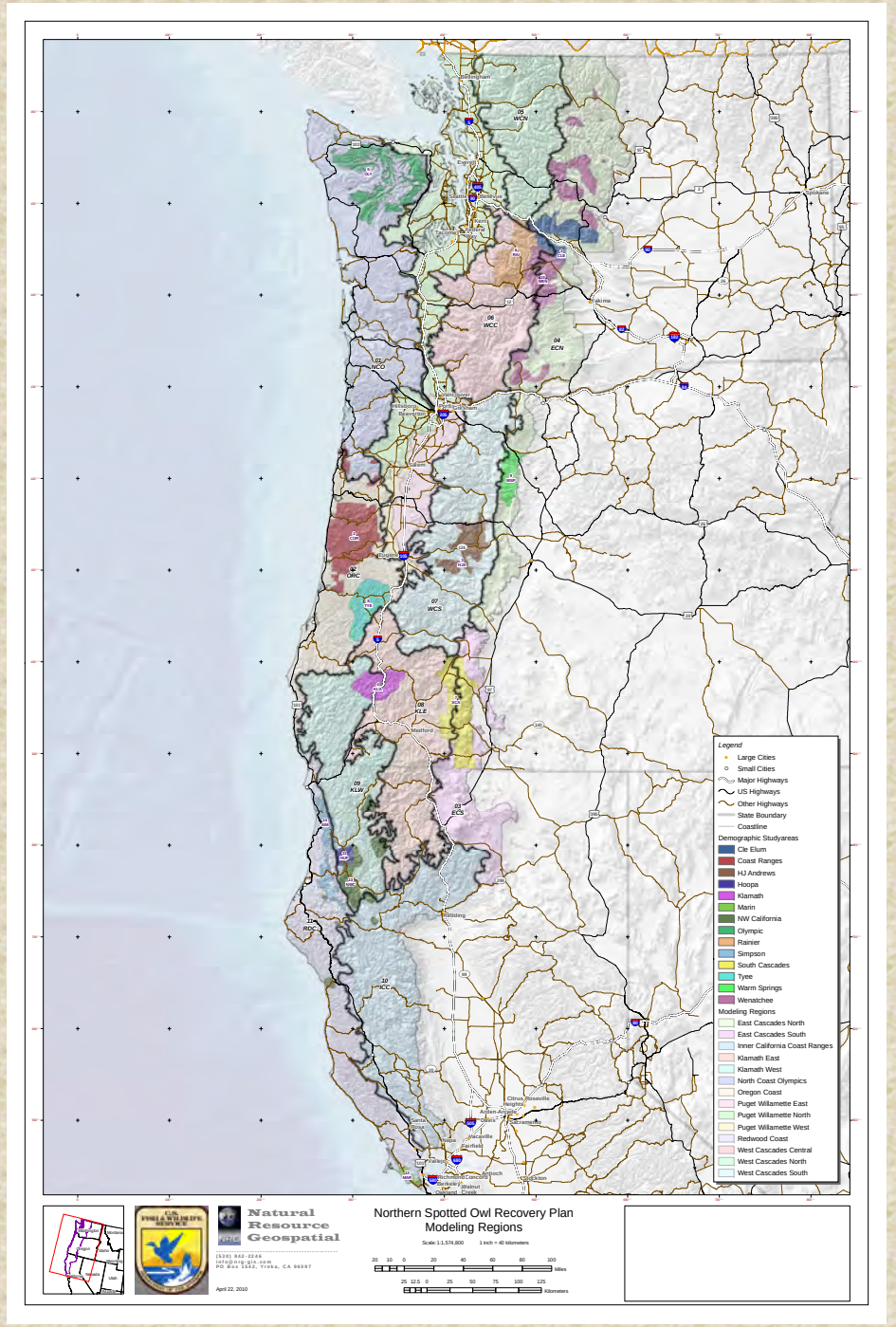


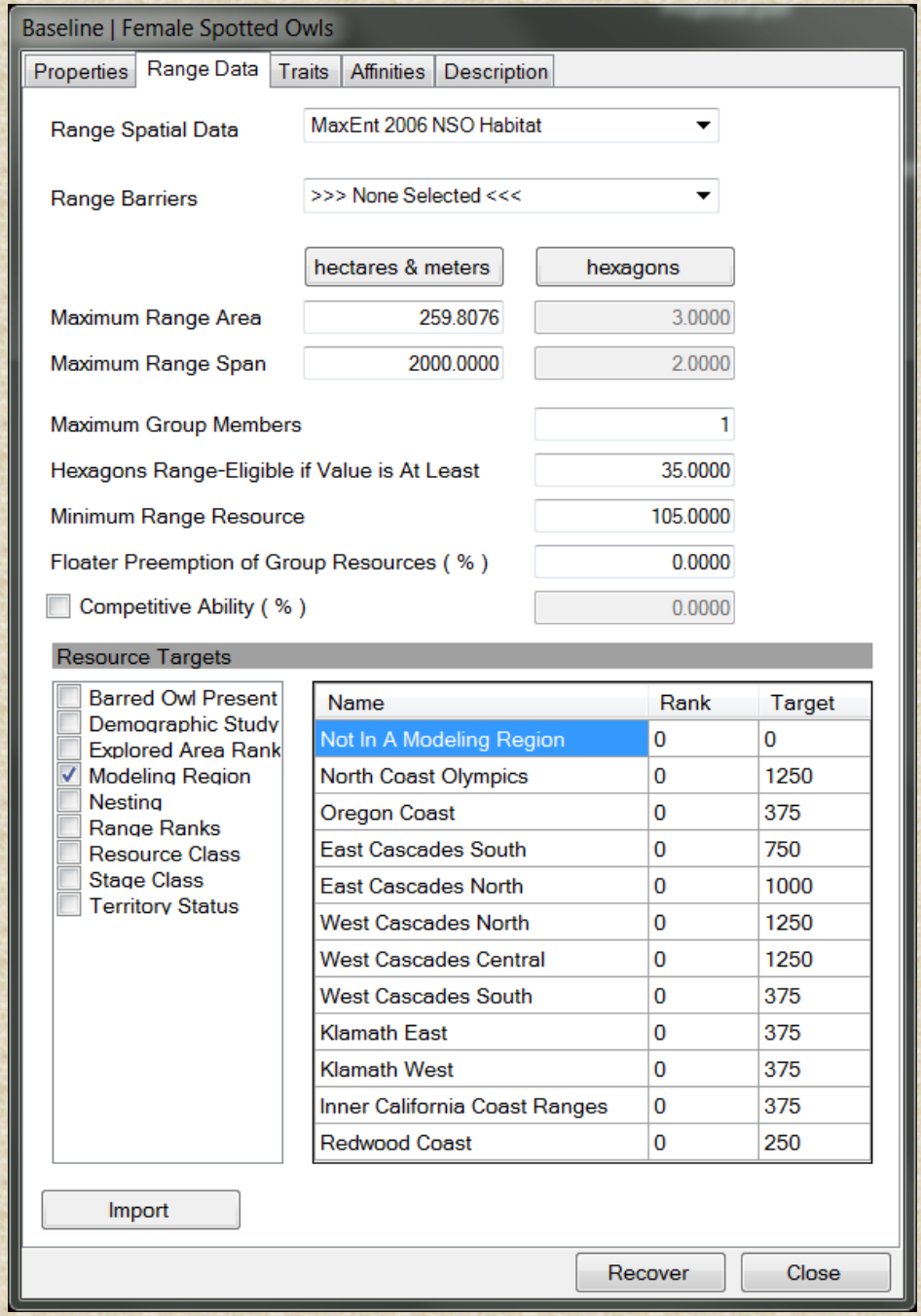
Lowest Quality





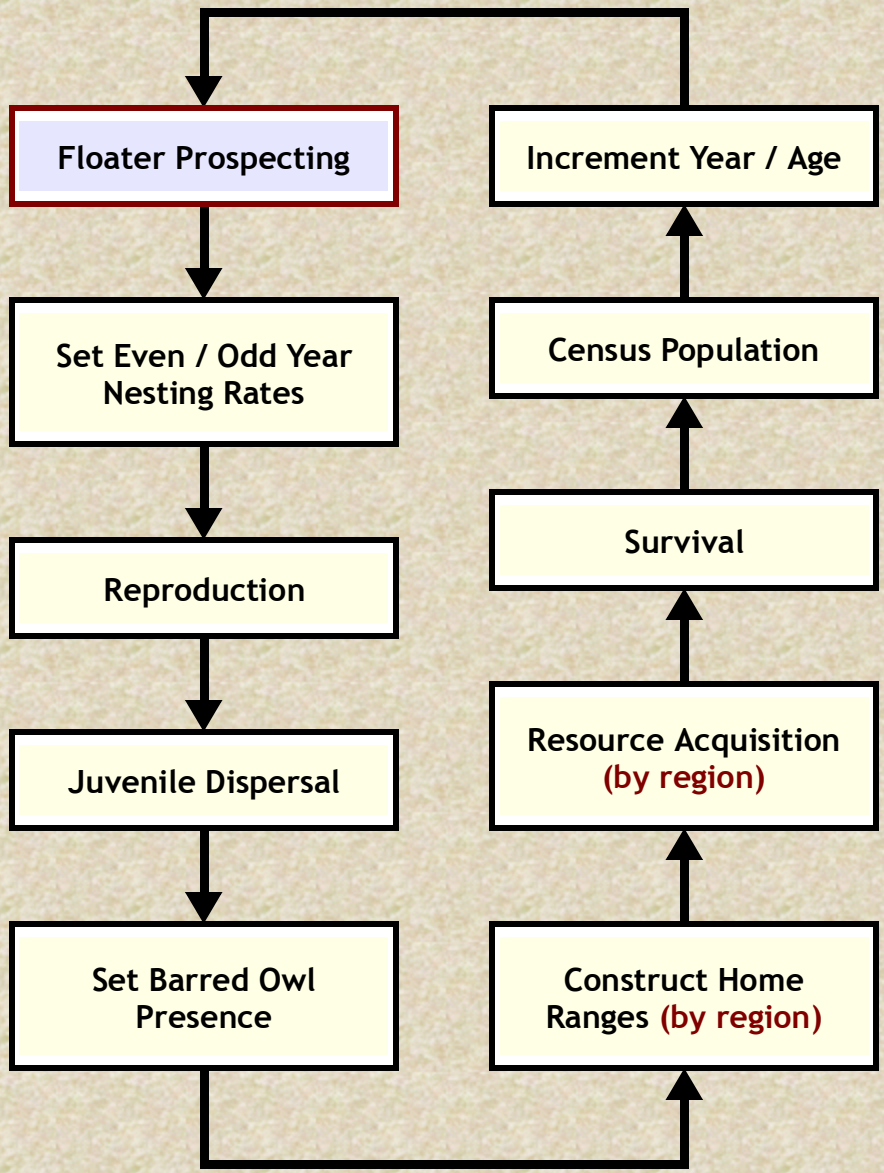
Modeling Regions and Demographic Study Areas





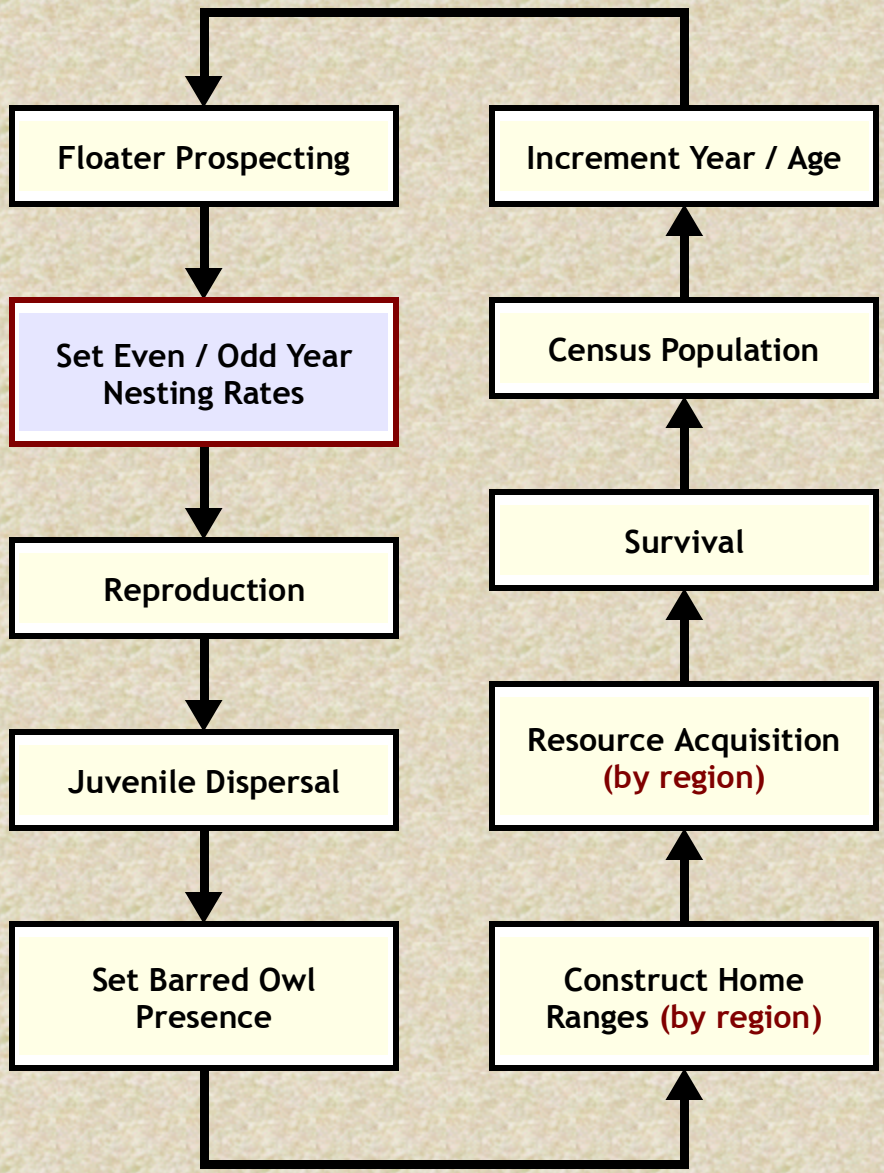
Territory and Home Range Data

- **Territory size small and constant (2-3 hexagons)**
- **Resources acquired from home ranges**
- **Resource targets stratified by region**
- **Resource targets mimic resource density**
- **Targets affect survival via acquisition classes**



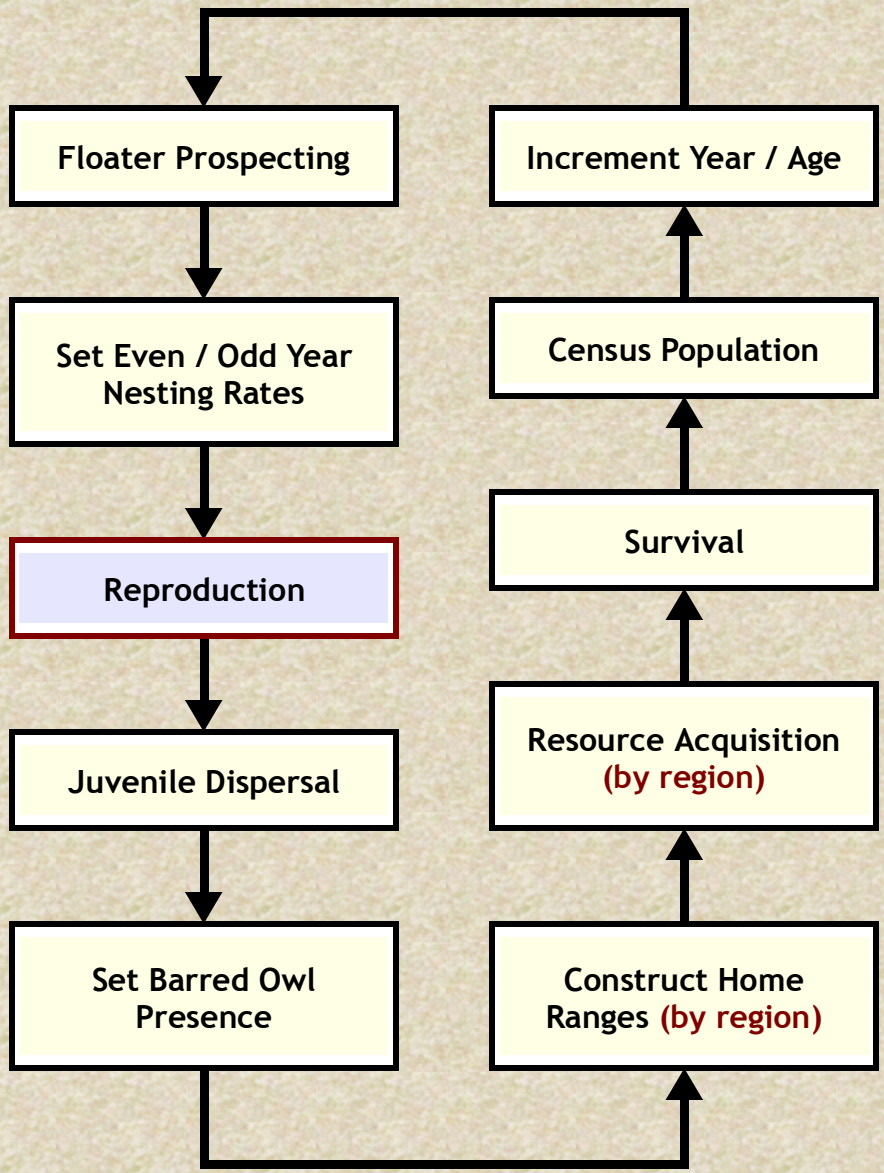
Floater Prospecting

- Applies to all non-territorial birds
- Search area is 500 hexagons (43,300 ha)



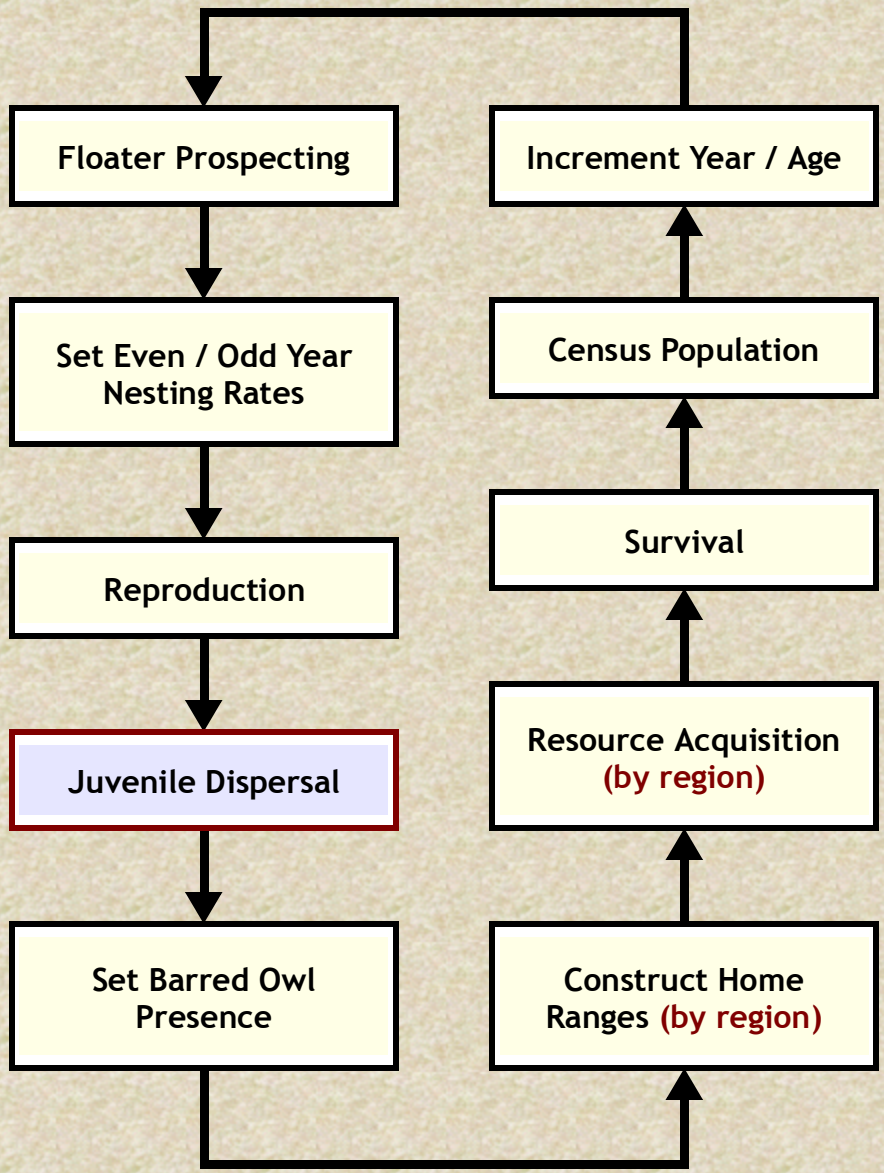
Nesting Frequencies

- In even years, P(nesting) = 70%
- In odd years, P(nesting) = 30%
- On average, P(nesting) = 50%



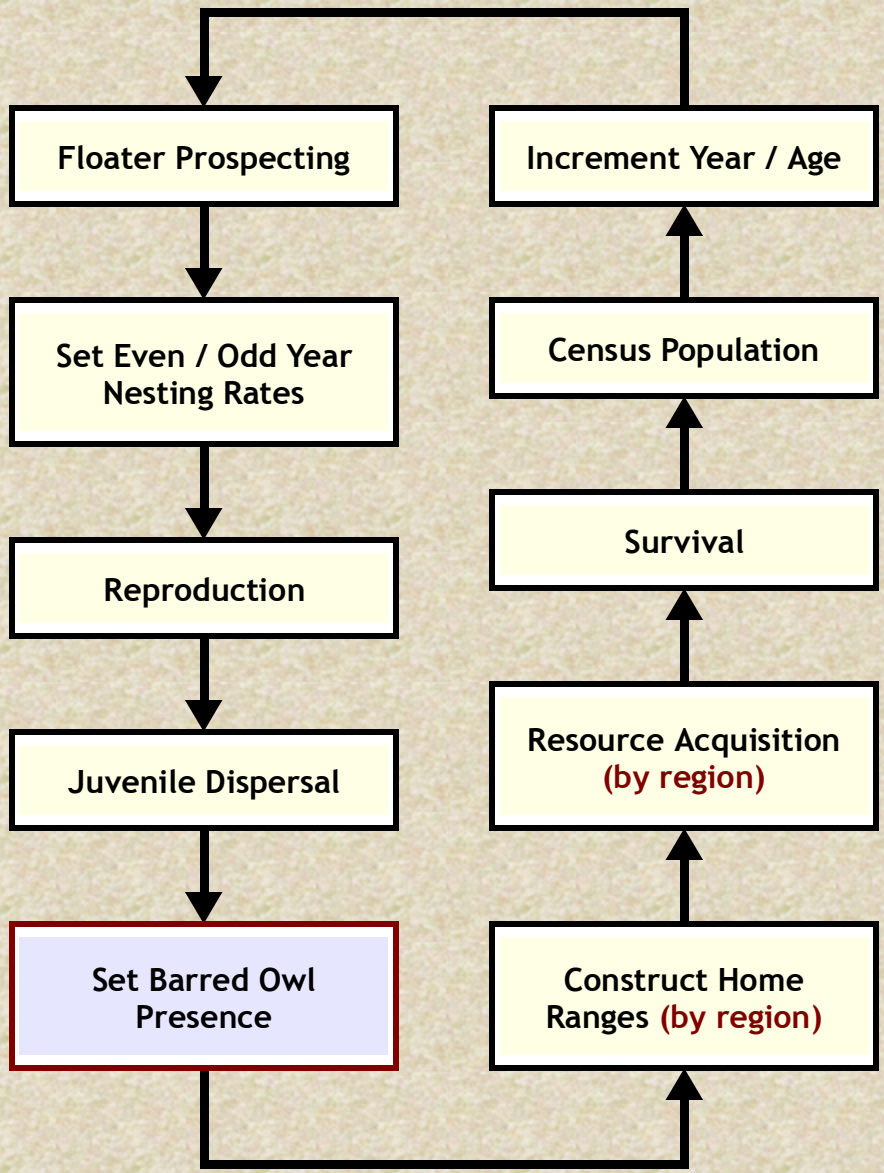
Reproduction

- **Fecundities taken from Forsman et. al. (in press)**
- ***Assumptions:***
  50/50 Sex ratio
  Clutch size = {0, 1, 2}
  P(1) = P(2)
- **Measured fecundities are females / female**
- **HexSim fecundities are females / nesting female**



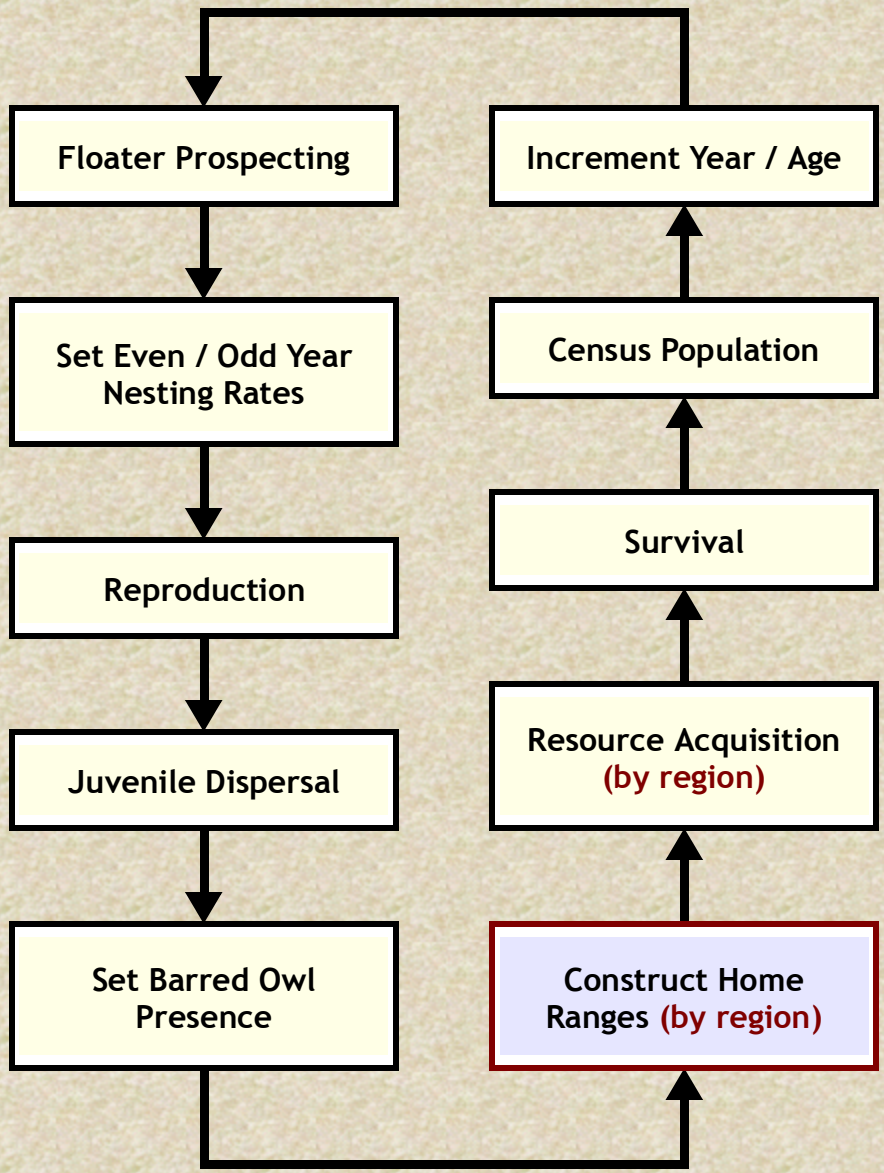
Juvenile Dispersal

- Dispersal only, no prospecting
- Move max of 250 hexagons (250 km)
- Stop if territory-quality resources are encountered
- Tendency to avoid very poor areas



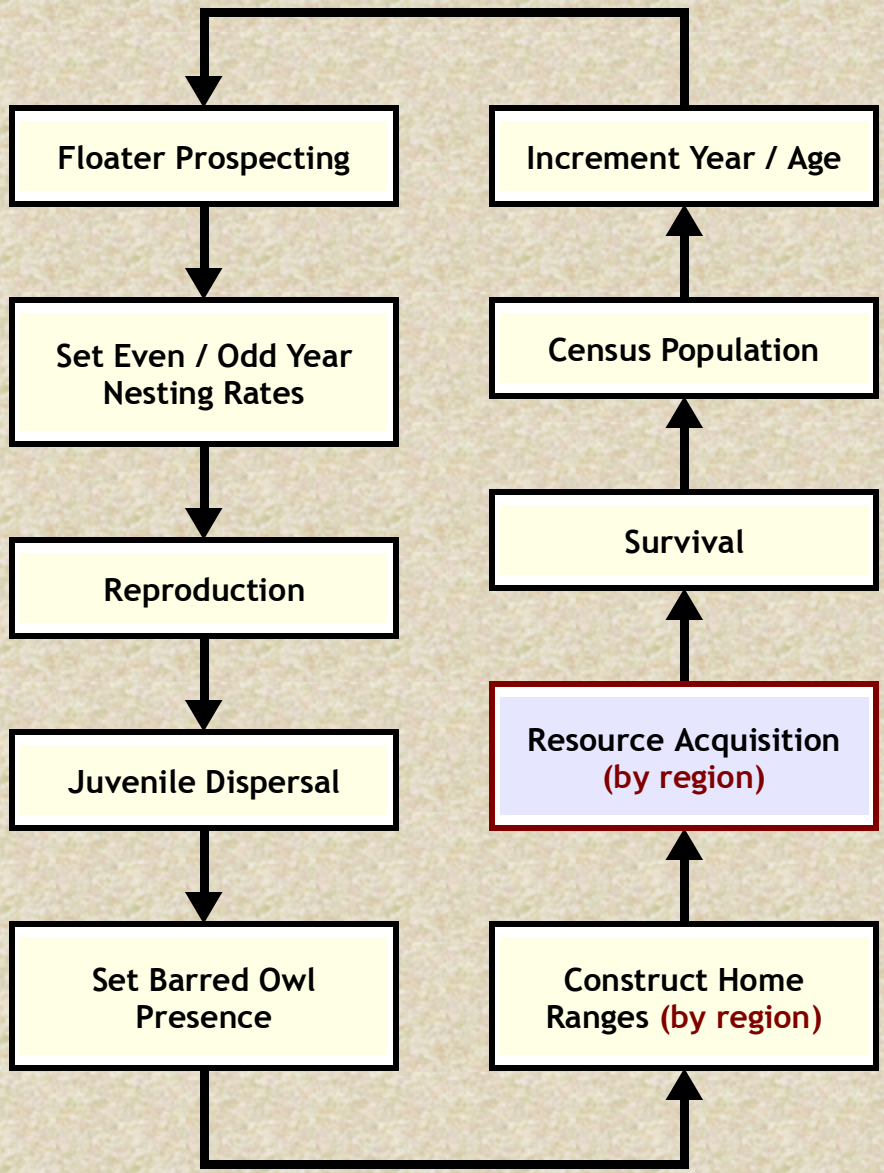
Barred Owl Impacts

- Barred owls affect NSO survival rates
- Stratified by region, otherwise non-spatial
- Barred owl impact is either on, or off
- Determination is made once per NSO



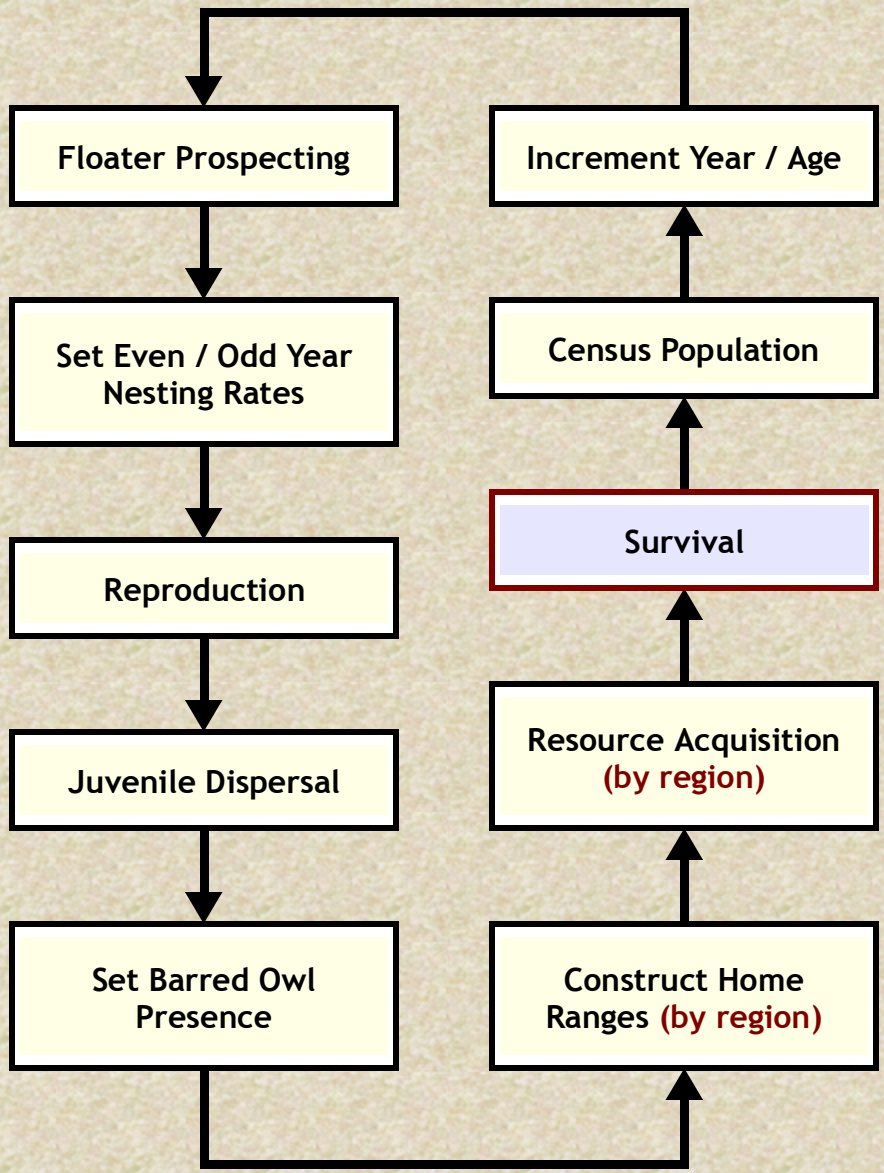
Home Range Construction

- Home ranges are allowed to overlap
- Home range size is stratified by region
- Owls share resources in overlapping ranges
- Search strategy is set to sub-optimal



Resource Acquisition

- Resources acquired from home ranges
- Individuals have equal competitive ability
- Owls assigned percent of a resource target
- Resource targets are stratified by region



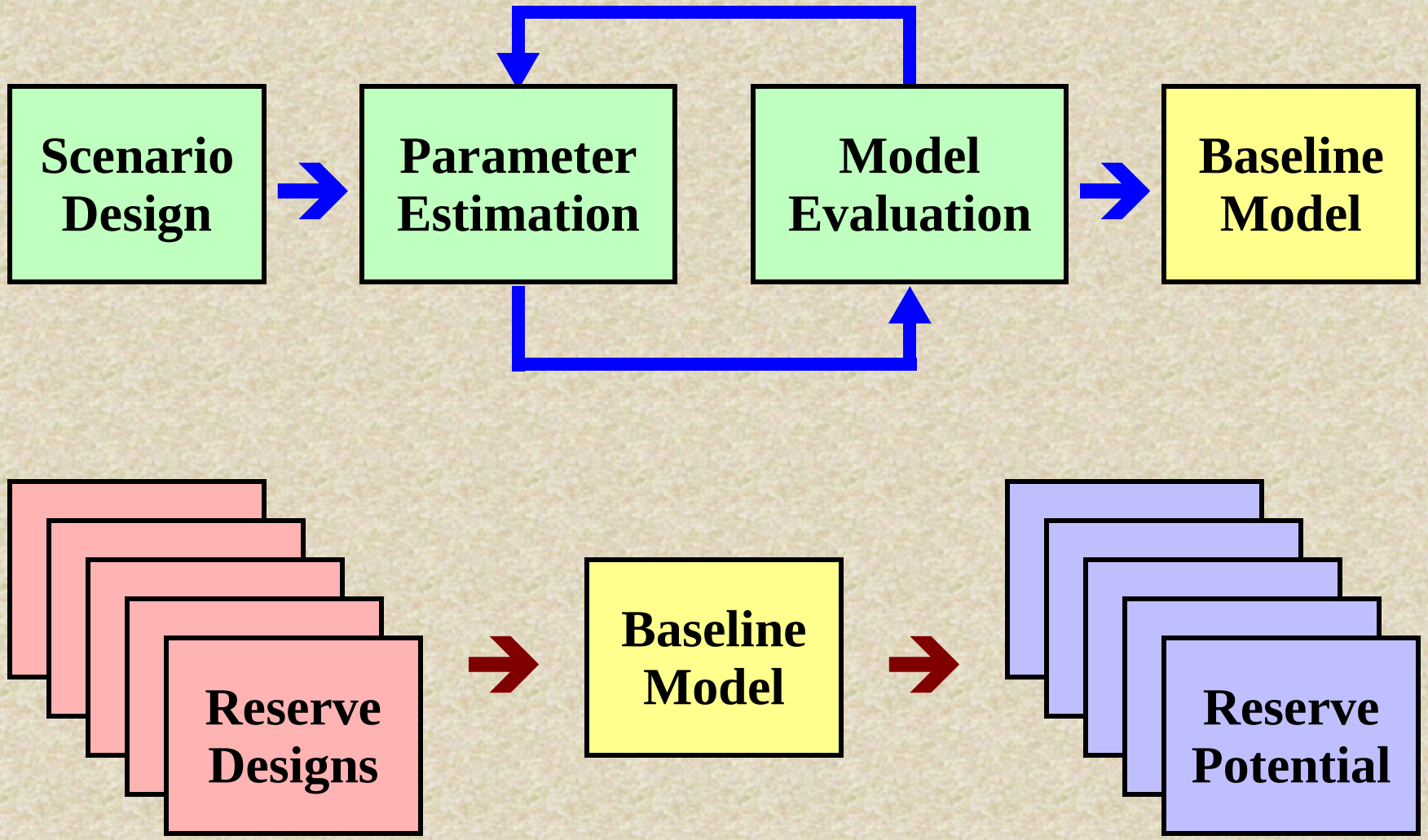
Survival

- Rates taken from Forsman et. al. (in press)
- Stratified by stage class, resources, barred owls
- Resource classes were low, moderate, high
- Barred owl impacts by Anthony & Dugger

Is our HexSim Model a Reasonable Approximation of Reality?

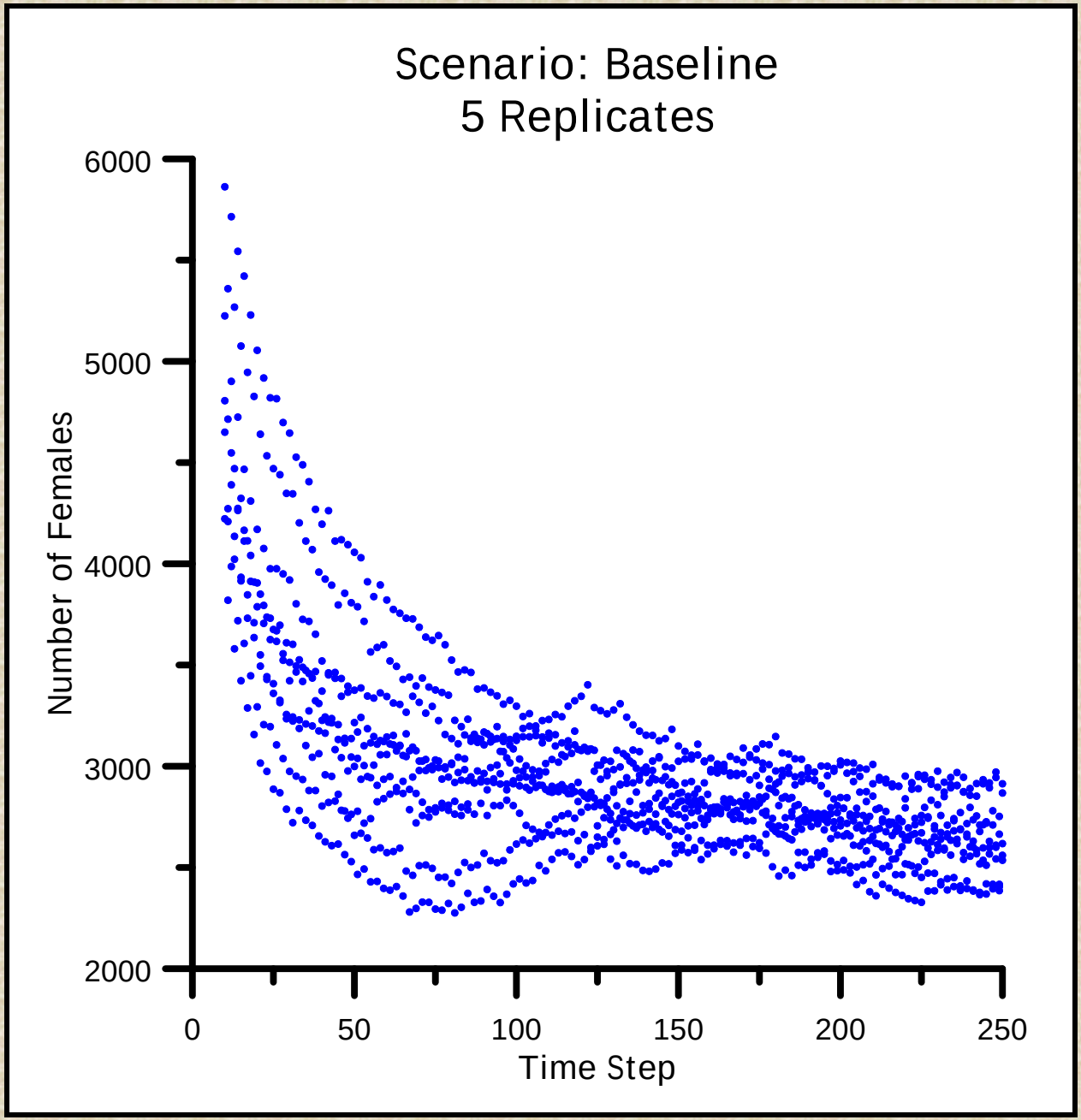
- **The scenario is actually quite simple.**
- **The life history events are parameterized using the latest data, and are conservative.**
- **When uncertain, we left features out.**
- **Our analysis plays to model strengths (for any model), such as relative change.**
- **Our results are easily replicated by others.**

Using HexSim in the Analysis



Example Results

Population Size (with Barred Owl Effect)



Example Results

Population Size by Modeling Region